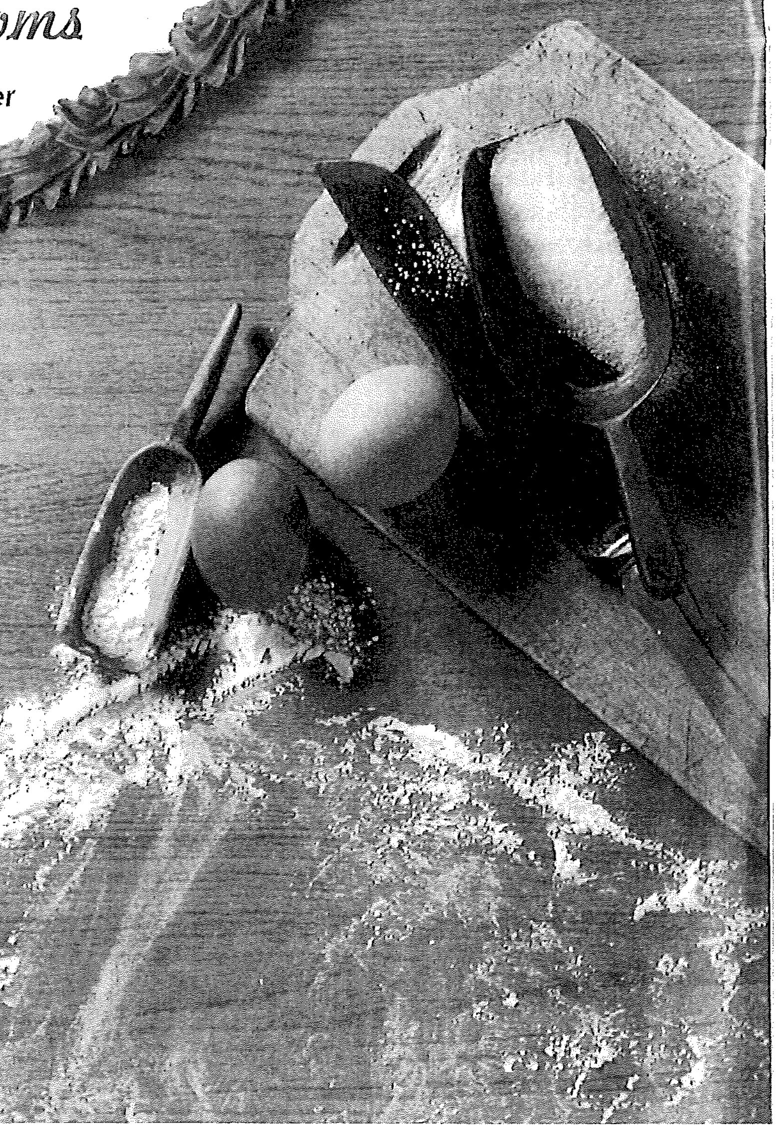
Deconstructing to Instruct

The Role of Deconstruction in Instruction and Assessment in Middle School Science Classrooms

by Rebecca Katsh-Singer

"You want us to do what?" "I don't get it." "I know how to do the first part, but what does that second part mean?" "We've never studied this before." How often does a teacher hear these phrases uttered? While it is sometimes a normal first step for middle school students to doubt their abilities (and want to delay work time), in other instances these statements are indicators that the instruction and assessment happening in the classroom are not tailored to student needs. We want to challenge our students, but we need to give them tasks and assessments they can realistically succeed at and are valid indicators of their learning. Deconstructing planning, teaching, and assessment can help teachers instruct and assess more appropriately, leading to more confident, motivated, and higher-achieving learners.



The deconstruction I discuss in this article is about pulling apart the assumptions we teachers make about student knowledge and previous learning. When we ask students to perform high-level tasks, are we appropriately challenging them, or are we setting them up for frustration? Think of a task that would be very challenging for you, such as baking a wedding cake. You probably know what a wedding cake should look like, and maybe you have tasted one. Perhaps you have baked another type of cake before. Does this mean that you can bake a fantastic wedding cake? Probably not. You must receive specific instruction, master certain techniques, and have prior hands-on experience before you can successfully make the cake.

We ask students to bake wedding cakes all the time in school. We ask them to write essays, design experiments, and analyze text without thinking about what they need to know to complete these challenging tasks. How valid is our evidence about student learning if we are using assessments that do not give us enough information about where student learning breaks down?

Deconstructing instruction: An example

When I taught sixth-grade Earth science, I used to ask my students to answer questions on assessments related to the chemical and physical weathering of rocks: "Given the following evidence of weathering, decide if the weathering was chemical or physical. Explain." Even my highest-achieving students struggled to give answers that were well written, scientifically complete, and accurate. Some students accurately interpreted the evidence, but supplied little explanation in their answer. Some students wrote about the difference between the two types of weathering. Few students were able to interpret the data, develop a conclusion, explain their reasoning, and support it with scientific information they had learned in class. We had studied weathering; why couldn't they do this?

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To determine why my students failed at this task, I first made a list of all the science knowledge and skills they needed to be able to answer the question successfully. In terms of knowledge, students need to know what weathering means, the differences and similarities between chemical and physical weathering, and the types of evidence that would support their conclusion to be able to successfully classify this evidence as referring to physical or chemical weathering. The scientific literacy skills required are also complex: how to read a data table, how to draw a conclusion based on data, how to write this conclusion clearly and accurately, how to write an explanation based on their conclusion using recalled facts.

Perhaps my instruction about chemical and physical weathering did not take into account the pieces that lead to a successful answer. Did I give my students enough opportunities to practice all of these skills? I decided that I would first teach the components of a successful answer and then help them put the answer together. The first step in this was the content. Could my students make a simple comparison between chemical and physical weathering? To find out, I gave them a quiz that asked them to contrast chemical and physical weathering and classify specific terms as belonging to physical or chemical weathering. I used the results of the quiz to identify students who would benefit from further review of these concepts.

This type of quiz and the instruction that followed acknowledge that students need to master lower-level cognitive activities before moving on to the higher levels. This is based on Bloom's taxonomy, which divides "cognitive objectives into subdivisions from the simplest to the most complex" (Bloom 1984, p.15). My students could not answer my higher-level question until they could successfully answer lower-level questions. Teachers may want to challenge their students with higher-level questions, but the mastery of lower-level questions must first be demonstrated to ensure success on items that require higher-order thinking skills. Without understanding the misconceptions and areas of weakness identified by lower-level questions, it would difficult for a teacher to successfully design instruction that would prepare students for higher-level questions.

The next step for my students was the reading and analysis of the data table. Some of my students were pros at this, and others needed help decoding the table itself. I started showing my students lots of data tables and asking them to summarize the pattern in one sentence. What I realized, however, was that I needed to back up even further for a few students. As a result, I worked with a small group of students who needed direct instruction about reading the table. Everyone did not need this instruction, but some students did. For these students, I first asked simple questions such as "How much water was used in trial 1 of this experiment?" and "How many different types of plants were used in this experiment?" The answers to all of these questions were contained in the presented data table, but students needed prompting to actually read the table. Had I not asked these lower-level questions, I would have been at a loss as to why some students consistently failed to appropriately analyze the table. Instead, I tailored my instruction to those students who needed it, and soon after they successfully demonstrated the ability to read a data table.

The last step for my students was the mechanics of writing the answer. What are the components of a strong conclusion? We practiced these pieces individually and then put them together. Students were challenged not only to write a sentence that summarized the results, but to support that statement with evidence from the data table. Again, by breaking up these skills, I could see which students needed specific instruction in certain areas.

I taught my students what a good answer looked like and the steps to get there. I gave them opportunities to practice at each stage of learning and to master small parts separately. Then, they could put everything together. This was not an easy process, and some students struggled more than others. However, when I again gave students the same questions about chemical and physical weathering, I got answers that provided valid evidence of student learning.

The role of deconstruction on assessments

One way for teachers to find out what students know and where their comprehension breaks down is to deconstruct questions on assessments. I use this technique on frequent content quizzes (see Figure 1). Instead of asking students to explain the variables in an experiment based on a given paragraph, I first ask my students simple comprehension questions. Then, I ask them to define the variables. The initial questions help me understand which students struggle with reading comprehension and which struggle with the concepts of variables. When I only asked about variables, I did not know if a student who answered the question incorrectly did not understand what variables were, could not read the paragraph, or could not use the definition of variables to identify the specific ones in the experiment. Now I know this information because of the decon-

FIGURE 1 Sample deconstruction of a quiz question

Use the following description of an experiment to answer the questions below.

Three students did an experiment to find out if waves travel faster through water, oil, or corn syrup. They dropped a rock from 10 cm above a tub of each liquid and measured how fast the waves moved from one side of the tub to the other.

Questions I used to ask	Questions I now ask
1. Identify the independent and dependent variables in this experiment. 2. Is this a fair test? Why or why not? 3. Write a hypothesis for this experiment.	1. What were the three liquids students used? 2. What did students measure in this experiment? 3. Identify the independent and dependent variables in this experiment. 4. What does it mean for a scientist to conduct a fair test? 5. Is this experiment a fair test? Explain why or why not. 6. What is a hypothesis? 7. Write a hypothesis for this experiment.

struction on the quiz, and can use these quiz data to tailor my instruction to student needs. Students who cannot adequately read the paragraph require a different intervention than students who understand the experiment but cannot figure out the independent and dependent variables.

The role of deconstruction in planning

When my assessments give me objective information about student knowledge, I can plan in ways that better meet students' current understanding and implement tiered lessons that target students in different ways. This type of data-based instruction allows both remediation and challenge for students. For students who are struggling with basic information, I can teach and assess at their level, enabling them to develop the skills to do more difficult and more cognitively demanding work. For students who are already performing at a high level, I can eliminate a lot of redundant practice and give them work that is challenging and more cognitively demanding. All students are expected to take the same summative assessments, but the formative assessments and class work can look different.

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When do I stop deconstructing?

I do a lot of deconstruction in my daily planning and frequent quizzes, but I do not deconstruct much on higher-stakes summative assessments such as unit tests and quarterly assessments. I initially struggled with this for several reasons. First, I was eliminating points that some students could earn on lower-level questions. For my students who could comprehend a paragraph about an experiment but could not explain the flaw in the procedure, those "easy" points were gone. Second, I would miss out on the data inherent in a deconstructed test. There would be no places to see where my students' learning breaks down. However, I decided that it was in the best interest of my students who would take the state standardized test in March to expect to see higher-level questions without the deconstruction "net" all the time. My students are going to have to analyze data without any simpler questions asking them how many beakers were used or what the three temperatures of water were. Likewise, if I deconstructed appropriately in quizzes and class work, and instructed based on this data, I did not necessarily need the same data on such a summative assessment.

Conclusion

Deconstructing assessments, planning, and instruction gives me a more comprehensive view of student learning. I do little guessing about what students need from me in terms of instruction. Instead, I have data to support my teaching strategies. I can tailor instruction to specific student needs—both students who struggle and those who need a challenge. Deconstructing has led me to appreciate the importance of a tiered classroom and work with colleagues to learn more about this practice and implement it in our school. Most importantly, I less often hear "I don't get it" from my students, and I more frequently hear "Oh, now I get it" and "I know what I'm doing." My students are more confident, more motivated, and higher-achieving learners. ■

References

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